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POWER AND GAS

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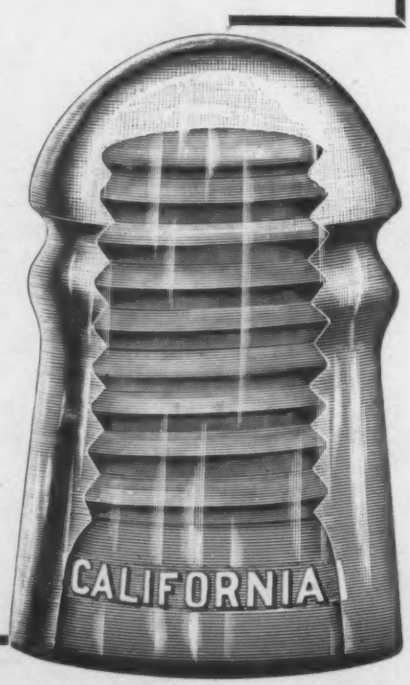

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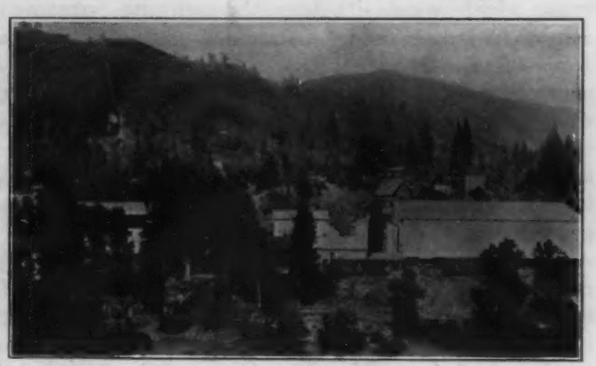


General View of Smelting Plant from Across the Pitt River. Incline Tramway in Left Background. Smelter Building in the Center Foreground; Lime Kilns at the Right.

ELECTRIC IRON SMELTER AT HEROULT ON THE PITT

BY RUDOLPH W. VAN NORDEN.
Member A. I. E. E., A. S. C. E.

About six years ago birth was given to a new child of California's industrial production, new only to California, but otherwise old almost as man himself. But it was different, far different from the world-old production in every other part of the earth. This perhaps is the reason it was new to California. California has almost everything, not excepting great deposits of iron ore. All of the pig iron used in this state has, however, come from the East, or from China, or in any event somewhere outside its limits. And this has been due to two reasons, inaccessibility and the high cost of fuel, so that the product which might have been made easily enough, could not have competed with pig iron brought into San Francisco and other ports in ballast. But California is blessed with many great water powers and the electrical energy generated therefrom can be taken almost anywhere.

A group of men headed by H. H. Noble, president of the Northern California Power Company, forseeing the great future possibilities of a market for pig iron which could compete with the imported product, conceived what has proven to be one of the nerviest projects which has ever been fostered in California. And the Noble Steel Company was the result of their determination to discover a method of converting the energy of the electric current into heat for the reduction of the unusually rich iron ores which they had acquired, at a cost to make this production commercially possible. The story of the development of this smelter, the heartbreaking trials, costly delays, unforseen misfortunes, repeated failures, always bolstered up and ready to go at it again by the indomitable courage and unswerving faith of these men, held together and helped and reassured through the untiring energy of their leader, will add a chapter to the glorious history of California, which, next to the satisfaction of the success which it will chronicle, will be a fitting tribute to the genius of faith and daring.

Electric furnaces of various kinds, mostly experimental, were in existence at the time this project was commenced. Induction furnaces were in use for converting iron into steel, and a number of inventors, mostly in Europe, had devised furnaces using an electric arc as a heating element. In most cases these were cumbersome and impractical.

In 1904, Dr. P. Heroult, a Frenchman by birth, took out patents in several countries on a single-phase arc furnace. One of these was built and put into experimental use at Sault Ste Marie, Ontario, and seemed to have promise of successfully solving the problem of smelting iron ores.

In 1906, Mr. Noble, after making a study of the various processes, arranged with Dr. Heroult to proceed with the erection of a furnace of this type. The quarry was opened, a narrow gauge railway and an inclined tramway were built. A charcoal oven on a small scale was erected and little by little an experimental plant was developed.

This Heroult furnace was built to use three electrodes and three-phase current supply instead of the single-phase type of the earlier experiments, and it was hoped to be able to commence on a small scale,

on its completion, the production of pig iron and thereby show that such production with the electric current was commercially possible. While a small amount of pig iron was produced which was encouraging, commercially the furnace was a failure, but was afterwards used to produce ferro-silicon. This latter material is used in the ordinary open-hearth furnace process and for a time it was produced at Heroult as a commodity.

After many trials it was decided to build a single-phase furnace, using two electrodes. This furnace went into the scrap heap. Another furnace expert came upon the scene and a new single-phase furnace was evolved, this time employing six electrodes.

The story of the ups and downs, and bright prospects soon shattered, is too long to recount here. The fourth furnace demonstrated the feasibility of electric smelting, but was mechanically weak, and then the fifth furnace was built and abandoned, the latter a very costly and intricate mechanism, was scarcely tried out before it proved an utter failure. And then came the sixth. This is more nearly like the original Heroult furnace than the others, although the resemblance is only general. It is simple, absurdly so, and one wonders that it was not thought of the first thing. And yet it is different from any furnace in existence. The wisdom of old furnace men, experts who understood the smelting of iron ore using fuel for heat, seemed to have failed. The new furnace seems to have been a final effort to gather together into a tangible whole, the ideas of those who were carrying out this work, but much of the credit must be given to R. E. Frickey, the electrical engineer who had charge of installing the furnace.

Does it really smelt? Does the iron run out when you want it to as those who claim to know say it does? Are they actually using electric power or is fuel being surreptitiously used? Can it be produced commercially? These questions have been asked for the thousandth time, not only in California, but all over the world. And the answer to all is: The furnace is running every day; there has been no interruption from any cause since September 5th; three times every day, at regular intervals, six tons of the highest grade soft pig iron is tapped from it. The electric furnace is an assured fact, a commercially successful machine, the forerunner of a great new industry, an untold potential wealth to add to California's greatness.

General Plan of Plant.

The location of the plant was determined largely by the location of the natural resources, iron ore, limestone, wood for fuel and the availability of low-priced electric power.

It is situated on the north bank of the Pitt River in Shasta County, at a point about one and one-half miles above the junction of the McCloud River with the Pitt, and about six miles above the confluence of the Pitt and the Sacramento rivers.

While the plant is not on the main line of the railroad, which winds its way through the Sacramento canyon, it is reached by a standard gauge branch road, known as the Sacramento Valley and Eastern, and rail shipments may therefore be directly made from the works.

The surrounding country is rugged, composed of irregular mountain ranges and deep valleys, heavily mineralized, partially timbered, dense masses of brush growth and altogether picturesque.

The plant proper covers an area of about 10 acres, extending along the Pitt River a distance of half a mile. It is necessarily built on a side hill slope, as the banks of the river rise from its surface on a heavy grade, which forms the ridge between the Pitt and the McCloud watershed.

In the layout of this plant, it must be borne in mind that this enterprise has, until a recent date, been of an experimental nature. Many of the devices for handling the raw materials and for the various processes were originally installed for operating on a small scale, sufficient for the development of a new process, and, except in a general way, the ultimate layout was a matter to be determined by the final results and the hoped-for success of the enterprise.

For this reason, it was not advisable to expend any more money on plant equipment than was absolutely necessary for the purpose in hand. Furthermore, much of the plant, due to the fact that there was little or no precedent to follow, was the result of inventive genius, fulfilling the needs which seemed apparent.

In any case, the problem originally presented the

General View of Quarries. The Lime Deposit Is at the Left and the Iron Ore Is Seen at the Right, Where the Men Are at Work.

handling or manipulation of five cardinal parts. There were the iron ore and limestone quarries to be opened; a method of transportation of sufficient raw material for experimental purposes; a means of getting charcoal for the furnaces; a means of getting lime also for the furnaces; and a suitable electrical installation delivering low voltage alternating current upon which the entire enterprise is based. In addition to this, a certain amount of income was available from the sale of by-products condensed from the fumes of the charcoal ovens, which would assist in compensating for the cost outlay of the work. There was also necessary substantial buildings, houses for employees, a water system, etc.

As the work has proceeded, these various parts have been replaced or improved, and as the success of the project has become manifest, many valuable and permanent improvements have either been made or are contemplated.

The Quarries.

In nature it sometimes seems that aside from forming the raw materials, they have been so arranged to assist man in perfecting its works. At Heroult a remarkable condition of this sort is manifest. High up on the mountain back of the plant, extending from an unknown depth in an almost vertical ledge to its summit, is a deposit of magnetite iron ore, probably as rich as may be found anywhere an earth.

This ore has a percentage of 70 in metallic iron. It is dark red, shading to a blue black in color, and is, of course, very heavy. It is easily worked and can almost be drilled, as it is so soft. The face of this ledge, which has been opened, is 90 feet wide and about 50 feet high. It may be seen in the view, the dark space at the right, before which a gang of laborers are working. Many test holes have been driven into the mountain at various levels to determine the extent of this ledge. The line of fault can be readily followed up the hill to the summit, and to all appearances the ore body is of great extent, sufficient to supply the needs of the smelter for an indefinite period. The deposit of limestone, which is necessary in making a flux for the molten bath in the smelter, adjoins the iron ore deposit. In fact, the fault which marks the limit of the iron ore body is also the dividing line between that body and the limestone ledge. There is much limestone in this country, which may be readily seen from the appearance of the adjoining peaks and ridges, the white crystalline nature of the rock giving much of the prevailing color effect.

These quarries being side by side, an extension of the tramway from the ore quarry was all that was necessary to obtain transportation for the limestone. The high face of the limestone quarry may be seen just beyond the face of the ore deposit in the picture of the quarries. The limestone is crystalline in nature and light in color. The finer-grained stone is superior for lime-making in the type of kiln used, as it will not disintegrate so readily after it is burned. As much of the rock is coarse, some care must be expended in the selection for use in the kilns.

For the present the quarries are worked by hand, but the time is not far distant when power in various forms will be needed in order to economically excavate the ore and rock necessary to supply the smelter.

The quarries are on the McCloud River side of the ridge, at an elevation above the works of about 600 feet. A two-foot gauge track is laid from the quarry faces on a grade sufficient to cause loaded ore cars to run by gravity, along the hillside, through a cut in a saddle of the ridge, and then along the contour of the mountain on the Pitt River side, a distance of one and a quarter miles to a point directly above the smelter. Here the track is carried onto a trestle which termintes in a head house. The empty cars are hauled back to the quarries by mules.

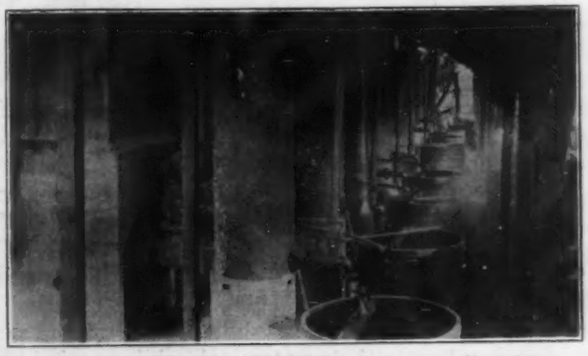
The inclined tramway, 1800 ft. long, which is 24 in. gauge, is laid on a tangent from the head house to the bottom of the incline. This has a maximum grade of 37 per cent.

From the bottom of the inclined tramway, the cars are switched over several lines of track to their destinations at the smelter or the limekiln, being hauled by mules.

At the works proper there are six main buildings—the boiler house, where steam for various uses is generated; the charcoal ovens or retorts; the refinery, where the by-products from the manufacture of charcoal are distilled and collected; the substation, which contains the lowering transformers, receiving current from the power transmission lines and delivering current at 2400 volts for all uses about the plant; the foundry building, which contains the electric furnaces, and which is the principal point of interest in the plant; and, finally, the limekilns.

The boiler house is a corrugated iron building, containing two Westinghouse, Church, Kerr return tube boilers, each rated at 100 h.p. These boilers use crude oil fuel, and have the regular complement of burners and oil feed pumps. There is also a Goulds 3-throw plunger pump, driven by a 30 h.p Westinghouse induction motor. This is installed for fire purposes and to augment the regular gravity service supply.

In the manufacture of iron, charcoal as carbon is necessary for the proper chemical reaction, whether the smelting is done by the ordinary processes, using fuel for heat, or by the electric process. Other forms of carbon, such as coke, may be used, but the charcoal, in this case at least, gives the most satisfactory product. The amount of charcoal needed equals in weight about one-fourth to one-third of the ore charge. It can readily be seen that a very large quantity of charcoal is thus consumed. Cordwood, from which the charcoal is made, is costly, no matter how easily it



Condensers and Tanks for Receiving Pryoligneous Acid at the Charcoal Retorts.

may be obtained, and together with the cost of fuel, attendance and the interest on the plant investment, represents a large part of the cost of the final product. The theory of making charcoal is simple; it consists of enclosing the wood in an air-tight chamber to prevent combustion, and then bringing the wood to a high temperature, thus driving off all volatile substances in which wood is rich, leaving the charcoal, which is practically pure carbon. As a great quantity must be in the making at any one time, the necessary plant is large. The by-products, which in the old-fashioned methods of charcoal manufacture were allowed to escape into the atmosphere in the form of smoke, are in themselves as valuable as the charcoal, and by saving them a large source of income may be derived.

The type of plant which has been in use here consists of a battery of eight retorts, each being a vertical cylinder six feet in diameter and sixteen feet high. In the bottom of the retort is a hopper, in which the fumes driven from the wood are led into a condenser, and the liquid thus received, known as pyroligneous acid, is gathered into wooden tanks to be later distilled and refined into its various constituents. The retorts are

"Yost" Charcoal Retort in Foreground. Boiler House Left Background and Refinery House Right Background.

mounted in a heavy concrete structure. Below them and to one side are the furnaces, one for each retort. These burn fuel oil. The carbon monoxide and other inflammable gases of the by-products are led through 3-inch pipes into the furnaces, to be consumed and assist the oil fire. The cordwood charge is loaded into a cylindrical container five feet in diameter and sixteen feet high.

Seventeen hours' firing is required to complete the charring process. The container is then hoisted out of the retort and taken to the cooling frame, this being necessary, as the contents are red hot. The cooling frame consists of seven steel drums placed in the arc of a circle, in which the loading crane is at the center. These drums contain water, and the container is lowered into the drum, the water coming far enough up the side of the container to form a water seal and prevent air from getting into the hot charcoal, thereby setting it on fire. Streams of water are now played on the sides of the container and continued for twelve hours, until the charcoal has become cool. The container is then raised and moved over the opening in the top of the storage bin, and the charcoal is dumped into it. The view shows three of the containers standing in their water seal, while one is hanging above the bin and is about to be dumped.

This description has been given as it is a method of making charcoal in wide use, especially in the Southern States. While a good part of the by-products are saved in this process, there is enough loss to justify the abandonment of this plant in favor of a newer system in which the added saving of by-products will soon pay for the cost of the change.

The Yost Charcoal System.

There are now in process of construction twenty retorts of the Yost system. An experimental retort was recently erected and tried out, with the result that it has been adopted. This retort consists of a steel cylinder five and one-half feet in diameter and twenty feet long. It is mounted horizontally in a brickwork enclosure. One end is closed, while the other is provided with doors. A track is led into the retort, and a car loaded with cordwood is run into the retort, which is then closed and sealed. The volatile by-products are led through a copper pipe fourteen inches in diameter, which tapers to six inches, to a near-by condenser, while the liquid tar is drained from the bottom into a tank. The furnace is fired with crude oil by the hot-plate system, oil and water are dropped in a fine stream on to a hot plate within the furnace, where it instantly spreads and volatilizes. This type of retort is much less costly, due to its simplicity, than the older type, and does away with much of the handling formerly necessary. Practically all of the by-products are saved. The condensers consist of vertical steel drums about two feet in diameter and ten feet high; they contain pipes through which the gases are taken. Water surrounding the pipes acts as the condensing medium.

The refinery building is of corrugated iron, two stories in height. The pyroligneous acid is pumped from the several wooden tanks adjacent to the retorts into a 5000-gallon rectangular concrete tank. From this receiving tank it is pumped to the various stills as needed. Steam is supplied for heating the pyroligneous acid preparatory to distillation. There are two 1650-gallon copper stills, from which the various ingredients, wood alcohol, acetic acid, wood oil, turpentine, creosote and finally acetate of lime are taken. An alcohol still of 1700 gallons further purifies and delivers into a large tank the wood alcohol for commercial use. There is an acetic acid still of earthenware, with coil of the same material, which has a capacity of 500 gallons. Two rectangular tanks five feet by eight feet, for the production of acetate of lime, which is the final product after all other ingredients have been removed, are also used for the creosote treatment of timbers, this liquid being led into these tanks. These are superimposed on steel tanks containing steam coils for heating the creosote.

With the installation of twenty Yost charcoal retorts, which are to be placed on land east of the present plant, on a fairly flat stretch of ground, and which are now under process of construction, the refinery building will be moved to this new site and enlarged to handle the increased supply of by-product.

Limekiln.

A short distance east of the smelter building and close to the railroad track is the limekiln installation. This consists of a battery of four 7½-ton capacity

kilns, built by the Mutual Engineering Company of San Francisco. These kilns are of the continuous type, in which oil is burned for fuel, and they are drawn down once every three hours. Fuel oil is run from cars into a sump below the track, and it is pumped from the sump by means of a 5-throw Seneca Falls pump, driven by a 5 h.p. induction motor, into a tank. There are two Cornish "low-down" marine boilers, which supply steam at 30 pounds pressure for the burners. The oil for the feed is pumped by Worthington duplex steam pumps.

The lime produced is not only used in the production of iron, but is is also shipped as a commercial commodity.

The water supply for all uses about the plant is from the Pitt River, and is pumped into two tanks. The pumps are in duplicate to insure a continuous service; they are mounted on an incline structure, which permits the raising or lowering of the pump units to accommodate the water level in the river. These units are 6-in., 2-stage, Byron Jackson centrifugal pumps, direct connected, and driven by 50 h.p. induction motors. There are two service tanks at different altitudes, the water being delivered into the upper of these, which is 174 feet above the river at low water. This tank is of timber staves, 15 feet high, and has a capacity of 25,000 gallons. The lower tank is at an elevation of 119 feet, is 16 feet high, and has a capacity of 50,000 gallons. The upper tank is used directly for domestic and fire service, while the lower one is to supply water for the furnaces and retorts.

Transformer Substation.

A new transformer house of sufficient capacity to supply current to the furnace equipment, which is now under construction and contemplated, is of corrugated iron and adjoins the furnace building. It is 20 feet wide, and 50 feet long, and is equipped with a 10-ton hand-operated traveling crane, with triplex chain block. There are six Westinghouse 1500 kw. oil-immersed and water-cooled lowering transformers, wound for a voltage ratio of 38,100 to 2400, to be Y-connected on the high-tension side for 60,000 volts supply. A two-panel distributing switchboard and oil circuit breakers occupy one end of the building. In an "L" a set of electrolytic aluminum cell lightning arresters and two sets of 60,000-volt oil circuit breakers with inverse time limit automatic control completes the substation equipment.

Heretofore the plant has received its electrical supply from a substation in a small brick building east of the smelter building. This contained three 750 kw. Stanley-G. I., 22,000-19,000 to 2200 volt oil immersed and water-cooled transformers, delta connected to a 22,000-volt supply circuit. Three 50 kw. transformers with ratio of 2200 to 220 volts are used for lighting and power about the plant. With the change of the transmission line voltage from 22,000 to 60,000 volts, the old substation has been abandoned.

Fuel.

Oil for fuel at various points about the plant, except for the limekilns, is run from tank cars into a steel sump tank close to the boiler house. From this tank it is pumped as needed.

The Electric Smelter.

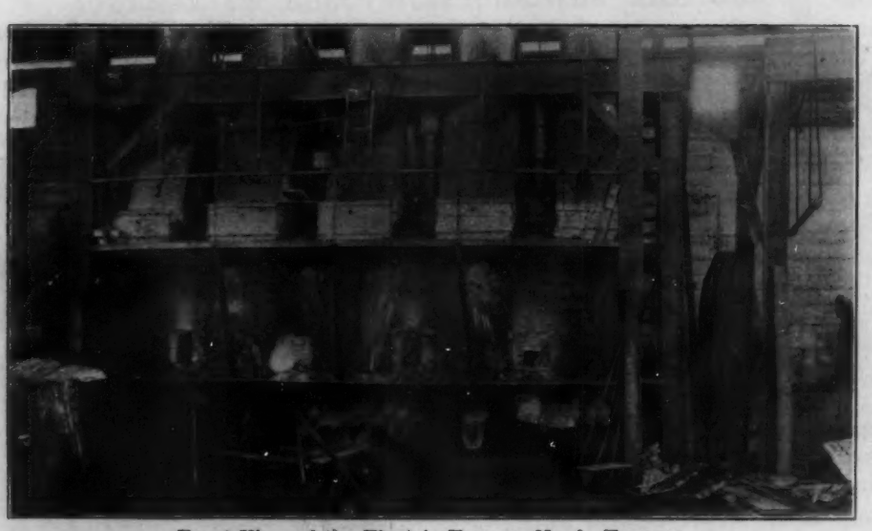
Something has already been said of the remarkable history which has been created by the many experiments, the failures and the final successful outcome

View of Copper Stills in the Refinery at the Left. Cooling Charcoal Containers and Discharging Charcoal Into Storage Bin on the Right.

of a means to smelt iron ores commercially with the heat generated by a three-phase alternating current electric arc. There are in existence several types of electric furnace, none of which were found suitable for this work. The present furnace is known as No. 6, and in its number is an eloquent testimonial of the devious types and forms through which the experiments have been carried to the final perfected design

The furnace building has a heavy steel frame, and is covered with galvanized corrugated iron. It is rectangular in shape, 120 feet long and 75 feet wide, and has a height of about 60 feet. Its position is parallel to and adjoining the railroad track. The 24-inch gauge track system of the plant has a track running through the building, with the necessary switches, turntables, etc. The building is in two sections or bays, divided by a line of columns. The more southerly of these is the pouring floor, on which the pigs are cast. Throughout this bay is operated a 50-foot Northern Engineering Company traveling crane. This is electrically operated and has two hoists, one of twenty and the other of five-ton capacity. A Cleveland Electric Controller and Manufacturing Company lifting magnet, having a capacity of 2000 pounds, is used in picking up the pigs. This magnet will lift about 1000 pounds of hot pigs.

The bay to the north of the center columns is given to the electric furnaces, their transformers and the necessary control. The furnaces, of which one has been in continuous and uninterrupted operation for the past two and one-half months, are placed in a line parallel to the length of the building, and are set so that their front side is even with the center line of columns. While but one furnace having a capacity of eighteen tons of pig iron per twenty-four hours is at present in use, two more of slightly greater capacity are practically completed. There is space reserved and it is intended to immediately construct three more, bringing the total number of furnaces in this building to six.



Front View of the Electric Furnace No. 6. Furnace No. 7 Under Construction at Right.

Like many successful devices which have passed through a tedious and intricate period of experimentation, this furnace is very simple. It is all contained in a steel box 27 feet long, 13 feet wide and 12 feet high. The upper half of the box is rectangular, but in the lower half the sides taper toward the center of the foundation. The box is lined with fire clay brick, on the vertical sides, the hearth of the same material slopes slightly from the ends toward the middle, to facilitate the flow of the molten bath, when the furnace is tapped. The tap hole is at the middle in front, and is ordinarily plugged with fire clay until it is time to tap. The roof of the furnace is arched, and has five stacks in a row. In the four spaces between the stacks at the center of the dividing arches are inserted the graphite electrodes, which are fed downard with the aid of jack-screws. Both the electrodes and the arched roof are water-cooled, this feature being essential to successful operation. The stacks or tubes, which are twenty-four inches in diameter, and which project upward from the roof a distance of fifteen feet, are not stacks in the ordinary sense, as there is no smoke or products of combustion given off, as would be the case in a fuel furnace. A small amount of combustible gases not consumed in the furnace is led away to a receiver and will be used in the firing of the charcoal retorts. Beyond this the stacks are used only for the purpose of charging the furnace. A charging platform is built along the top of the stacks and carries a track which runs to the mixing platform. Dump cars with the charge are run on the charging platform and dumped directly into the stacks. Except when receiving a charge, the stacks are closed with a tight-fitting cap.

In the rear of each furnace, and as close thereto as is possible, are the three service transformers, which supply three-phase current at from forty to eighty volts to the electrodes. These transformers are oil-immersed and water-cooled, have a capacity each of 750 kw. The low-tension connections to the electrodes consist of eight pieces of flat copper bar, three-eighths of an inch thick, and five inches wide, bolted together. On the 2400-volt primary side, there are brought out eight current taps for voltage regulation. These are taken to an oil-immersed, individual solenoid-operated switch group, which, with anto-transformer compensator, gives fifteen steps for voltage variation.

The electrodes are made of compressed graphitic carbon; they are cylindrical in form, twelve inches in diameter, and four feet long. The upper end has a tapered male-threaded nipple, while the lower end has a corresponding socket with a female thread. As the electrode is fed into the charge a new one may be fastened to it, making a continuous feed.

An electrode lasts in continuous operation thirty days. Occasionally an electrode breaks in the furnace. At first the detection of a break appeared to be a serious matter, but an extremely simple means of finding this out was evolved. A bar is driven into the furnace opposite the electrode, through one of the several peep holes, and at the same time the electrode is tapped on top with a hammer. The man on the bar simply listens for the tapping. The tapping is then done on the bar and the man on top listens. A break may be accurately located in this manner.

Electric control is through a switchboard, there being a panel for each furnace. As the current and power factor in each phase must be under observation at all times during operation, separate meters are installed in each phase. The requirement for one panel are three ammeters, three voltmeters, three wattmeters, three power factor meters and three recording wattmeters. These are mounted across the panel in rows of three each. Under the first four sets named are three hand wheels to control the voltage variation, and under these three switches, which control the entire load, and still under these are the recording wattmeters.

For operating the voltage control and the main circuit breakers there is a 7½ kw. motor-generator set, comprising a 125-volt d.c. generator, direct connected to a 10 h.p. induction motor. This set has a small panel board mounting a circuit breaker, ammeter, voltmeter, and two single pole knife switches. The transformers, switches and control were supplied by the General Electric Company. In the event that line voltage should fall, or for any other cause, the direct current supply should become deranged there is a National Storage Battery Company's set, having a ca-

pacity of 7½ kw., which may be instantly switched in, and thus prevents the furnace from cutting out in the case of low voltage.

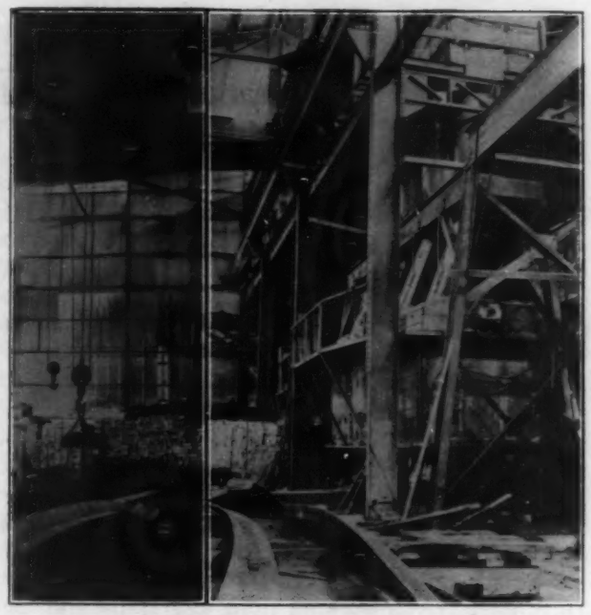
Operation.

In operation the electric furnace is so different from the ordinary blast furnace, and there are so many unheard-of or unlooked-for effects, that the old experienced furnace man, who knows by the sound or by the appearance or by any of the mysterious signs which he alone understands, the condition of the furnace or the condition of the charge, would be helpless should he attempt to operate the electric arc furnace. So far as sound or visible manifestation is concerned, one might stand beside it and not know whether it were cold or whether the bath were ready to discharge its six tons of molten metal over which was being dissipated in the terrific heat of 4200 degrees Fahrenheit the 3000 horsepower of electric energy. There is scarcely a sound. On the charging floor it is different, as considerable heat escapes there, and while a charge is being loaded into the furnace there is ample manifestation of the internal activity.

The furnace operates in a partial vacuum; that is, no air is allowed to get inside. The electric arc travels between the electrodes, which are buried in the charge, and supplies the heat for smelting. The oxygen of the iron ore combines with the carbon, forming not only carbon dioxide, but also carbon monoxide, and many of the higher series of hydro-carbons. In fact, the furnace may be tapped at certain points and draw off one or the other of these gases.

In operation the furnace is continuous. After a period of eight hours the hearth contains a full bath of molten metal, and this is therefore tapped three times each day. Charging is done at regular intervals, and the current is not shut off at any time. When the time for tapping arrives, the pig moulds having been built up in the interim after the previous charge, the furnaceman simply drives a bar through the tap hole and the iron comes out. At first the iron with most of the impurities, particularly the silicon content, comes. This is manifested by the brilliant, but short-lived, display of scintillating sparks; then comes a steady flow of the highest grade, soft, even-grained pig iron that can be produced. After the iron has all run out, the slag follows, and is diverted into the proper channel. In fifteen minutes the heat is over, the tap hole is plugged, and a new bath is in progress of smelting.

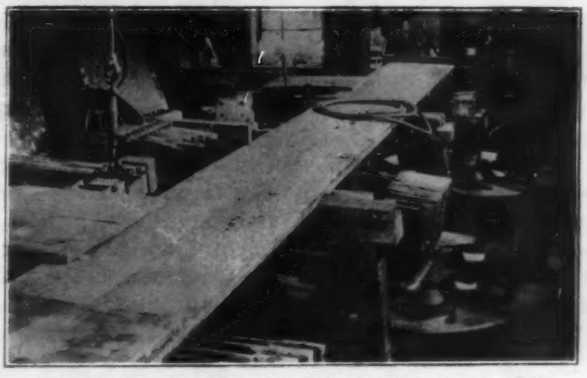
During the period of smelting the change in electrical conditions is interesting. At the beginning of the charge the power factor is almost unity. This gradually lowers as smelting continues, until with a full bath of metal a power factor of about 65 per cent is reached. If coke is used in place of charcoal, or if a mixture is employed a different set of power factor conditions exists. By studying these conditions, it is possible to know the exact condition of the charge by looking at the meters. The load is, of course, a function of the voltage, and with half voltage the load will drop to one-quarter. The consumption of the electrodes constitutes a heavy charge against production. It is offset, however, by the much greater life of the furnace lining than in the case with gas or oil fuel furnaces.



General View in Smelter Building. The Electric Furnace Is on the Right. A Portion of the Casting Floor, Crane and Lifting Magnet, on the Left.

In charging, the ore cars are run on the mixing floor, which is at the same level as the charging floor. Cars with charcoal come into the lower part of the building and are hoisted on an electrically operated elevator to the mixing floor. Lime and quartz for flux are also brought in in cars, and each material is dumped into bins. The mixing is done in a car which is run on a platform scales. The charge is placed in layers, the proportions depending upon the tests made in the laboratory by the chemist. Following is a representative charge:

500 pounds iron ore (Magnetite).
135 to 150 pounds charcoal.
3½ pounds lime (well burned).
12½ pounds quartz.



Tansformers in Rear of Furnace Showing a Set of Secondary Conductors.

Smelting by the equipment installed is in daily operation, and the completion in the near future of additional furnaces, the new Yost charcoal plant, and the added plant equipment for handling a much greater output, will make the supply of pig iron in California an important addition to the great natural resources of which the state is so highly favored.

READINESS TO SERVE METHODS

INTRODUCTION—SUMMARY AND EXPLANATORY.

BY R. B. MATEER.

Articles descriptive of electrical progress since 1882, when the first central station of 250 lamps was placed in operation at Appleton, Wisconsin, give the number of generating stations as now exceeding 8000, and some possessing individual capacity in excess of 100,000 kw., all the result of electrical activity and the progressive methods of those shaping the policy of hydroelectric development.

Granting the rapid growth in the number and capacity of generating stations, has it occurred to you that the remarkable increase in generating equipment, requiring an investment of over two and one-quarter billion dollars is not the result of the promoting capitalist, but rather of the concentrated efforts of the commercial engineer, the central station operator and the manufacturer all working along aggressive and consistent lines in the centers of population? That the steadily increasing demand for "juice" is the natural sequence of commercial effort resulting in the use of current for the illumination of the home and the shop, the operation of the factory, the propelling of train, car, and vehicle in city and hamlet. Additional business will be secured from present urban consumers, as public utilities appreciate the advantages of electric cooking and heating, and grant rates that are conducive to the use of such appliances, but will the central station selfishly confine its efforts to the city, where constant shifting of consumers require a maximum of educational expense, or will the management of public utilities awake to the wonderful opportunity for increased current sales in the agricultural and rural sections, bringing electric service within the reach of the farmer?

The applications of electricity to the farm are manifold. Larger revenue per dollar invested, covering a longer period of time per consumer, is possible from the agriculturalist than from any other source. To develop such a field of profit a quasi-public utility must bring its service within the reach of the rural user, and demonstrate how electricity may be used advantageously.

The general lack of appreciation of the value of agricultural business by the central station, the hesitancy with which it grants a line extension which in a short time yields immense profit, the unwillingness to spend a liberal amount of money, commensurate with its ultimate value in educational purposes, lead to a series of papers in which motor and current consuming devices for farm house and field purposes will be discussed in the hope that the apathy which characterizes many central stations may be cast aside and a liberal, aggressive policy pursued in the development of the great revenue producing field, that of agricultural current sales.

It is evident that to develop the sales of current for agricultural purposes a plan of campaign must be pursued that in some respects is identical with that used for the securing of city business, yet deviating in many ways from the system of urban solicitation as now practiced by the majority of up-to-date central stations.

Summarizing, it should be remembered that it is the duty of the utility to bring its service within reach of the farmer and, where necessary, show him how to use it advantageously, all of which involves large expenditures commensurate with the development of the latent possibilities in rural business. On the other hand, the agriculturalist, the representative of the real wealth of any nation, is often a man of education who applies scientific principles to farming and is willing to utilize every means of increasing the productiveness of his land.

Co-operation with the farmer is mutually advantageous, representing as it does readiness to be served on the side of the agriculturalist.

Including the present paper, there are to appear sixteen separate and distinct discussions along the line of agricultural sales. These articles will cover many phases of "Readiness to Serve Methods" applied to Western rural communities and in brief are as follows:

1. Introductory—Summary and Explanatory.
2. Organization—agricultural sales department.
3. Card systems for records.
4. Methods of approach to customers.
5. Modernizing the country home.
6. Modernizing the farm buildings.
7. Electricity on other parts of the farm.
8. Electricity and irrigation—old methods.
9. Electricity and irrigation—new methods of water storage.
10. Electricity and reclamation—construction of system.
11. Electricity and reclamation—operation of system.
12. Electric transportation possibilities.
13. Investigation Bureau.
14. Publicity.
15. Suggestion on agricultural rates.
16. Country life vs. city.

PANAMA CANAL TOLLS.

1. On merchant vessels carrying passengers or cargo, $1.20 per net vessel ton—each 100 cubic feet—of actual earning capacity.

2. On vessels in ballast without passengers or cargo, 40 per cent less than the rate of tolls for vessels with passengers or cargo.

3. Upon naval vessels, other than transports, colliers, hospital ships and supply ships, 50 cents per displacement ton.

4. Upon army and navy transports, colliers, hospital ships and supply ships, $1.20 per net ton, the vessels to be measured by the same rules as are employed in determining the net tonnage of merchant vessels.

ELECTRICAL PUMPING AND IRRIGATION

DESIGN OF CANAL CROSS SECTIONS.

BY B. A. ETCHEVERRY.

Considerations Entering Into the Design of the Form of Canal Sections.

The section with the best hydraulic elements is not in many cases the most feasible, for there are practical considerations which will often justify a shallower section of the same carrying capacity. The factors on which the design of cross sections for irrigation canals is based are:

1st. The cost of construction for lined and unlined canals.
2nd. Safety.
3rd. Absorption, percolation, evaporation.
4th. Purpose for which canal is to be used.
5th. Limitations because of grade and velocity.

1st. Cost of Construction.

The cost of excavation will depend not only on the volume, but also on the unit cost of construction which is affected by the depth of excavation, the side slopes, the material which may be encountered by increased depth, etc. When a canal is lined, the cost of lining,

Concrete Lined Canal, South Kelowna System, British Columbia.

especially if concrete is used, will be the main item. To make it a minimum, it may be best to use the cross section having least wetted perimeter. The decreased cost of lining for such a section and the smaller volume of excavation, especially on hillsides, will often more than balance the unit cost of excavation.

2nd. Safety.

The safety against breaks is dependent on the depth of water in the canal and mainly on the proportion of this depth which is in fill. In a deep canal, the pressure, which depends on the depth of water, can exert a greater force on the banks or can produce a larger velocity through holes or breaks started by burrowing animals.

3rd. Absorption, percolation, evaporation.

The first two factors are intimately related and the relation depends on so many varying conditions that it cannot be stated numerically. The losses due to these two factors are commonly spoken of as seepage losses. By absorption loss is meant the loss due to the action of capillarity; and by percolation, the loss due to the action of gravity. If in a canal capillarity alone were acting, then the loss of water through the soil would follow the laws of capillarity. The water would pass from the wet surface to the dry soil surrounding it, moving horizontally as well as vertically, and would stop when it had reached the maximum limit of capillarity, which varies with the

Heavy Rock Cut, Truckee Canal.

character of the soil. This capillary area surrounding the canal may, especially with canals in embankment, extend up to the surface and some of the water will be lost by evaporation. This action as well as evaporation caused by the air motion in the soil, will produce a continuous rate of absorption, which, however, is not of great magnitude. It is, however, modified by percolation. The water lost by percolation travels downward, because of the force of gravity, to the subsoil beyond the above limit of capillary action. This water is disseminated laterally by capillarity and in that way the capillary area is increased. The water loss by percolation will, if sufficient, ultimately reach the water table and pass as an underflow to a drainage channel. The percolation loss is, no doubt, of much greater importance than the absorption loss. The absorption loss will vary with the wetted perimeter, with the character of the soil, and with the position of the canal, whether in cut or fill. The percolation loss caused by the water passing from the canal into the subsoil through the small, crooked channels formed by the interstices between the soil particles must depend on

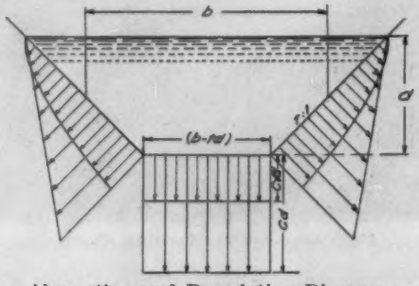
the depth of water in the canal. The most reliable formulae derived for the flow of water in capillary tubes or between soil particles show that the velocity increases with some power of the diameter of the particles, and with the first power of the slope or head. That it may vary with the square root of head instead of the first power is shown by the following experiment made by the Irrigation Investigations Office of the United States Department of Agriculture. Tanks were filled with three feet of soil, held by a mesh screen at the bottom; a constant depth of water was maintained on the surface of the soil, and the seepage water caught and weighed. With an ordinary clay loam the following results were obtained:

(1) Depth of water in inches.	(2) Square root of depth.	(3) Pounds of water lost per hour.	(4) Ratio of square root of depth to loss of water in pounds.
36	6.	4.51	1.33
30	5.47	4.06	1.34
24	4.90	3.48	1.40
18	4.24	3.11	1.36
12	3.46	2.68	1.30
6	2.45	2.38	1.03

These results should not be taken as conclusive.

Other factors affecting absorption and percolation are the height of the ground water level, the temperature and the velocity of flow in the canal.

An increase in temperature decreases the viscosity of water, which will increase the rate of percolation, In a shallow canal the temperature of the water is higher than in a deep canal.



Absorption and Percolation Diagram.

The velocity of water in the canal affects the seepage loss, because the water moving at right angles to the capillary and percolation flow interferes with it. Experiments made by the United States Department of Agriculture show that the seepage loss is greater with still water than with water in motion. A very small velocity does not seem to make a great difference, but a moderate bottom velocity, probably of 1.5 feet per second for shallow canals, and greater for deep canals, has a great effect. A velocity higher than this will further decrease the seepage, but the difference will not be so marked as the difference between 0 velocity and 1.5 feet per second (greater for deep canals). To summarize the above considerations, it is probably safe to state that seepage increases either with the first power of the depth or perhaps with the square root of the depth of water in the canal, with the temperature, and with the wetted perimeter, and it decreases with an increase in canal velocity.

The evaporation loss is usually very small, as compared with the seepage loss, and in most cases need not be taken into consideration in designing irrigation canals. On one of the largest systems in the San Joaquin Valley it has been estimated that for a total length of canals of 165 miles the evaporation loss was .9 per cent of the flow diverted; the total seepage loss was 28 per cent, or 30 times greater.

4th. Purpose for Which Canal Is to Be Used.

A canal may be intended for (a) a diversion line, (b) main laterals, (c) private ditches and farm ditches. For a diversion line, especially on a side hill, the deeper section has the advantage that it requires less excavation and has a smaller wetted perimeter. This will decrease the cost of excavation and also the cost of lining where the canal is to be lined. On the other hand, the safety is not so great. For main laterals, and especially farm laterals, it is important that the main body of the water be kept as high as practicable with respect to the ground surface.

5th. Limitations Because of Grade and Velocity.

When the grade available is large and to reduce the necessity for falls, it may be necessary to use a shallow section to obtain velocity which is not excessive. When the grade is small it may be desirable to use the section with greatest hydraulic radius to obtain the maximum velocity.

[To be continued.]

ELECTRIC RAILWAY AMENDMENTS TO SAN FRANCISCO CHARTER.

Bion J. Arnold's Preliminary Report No. 13 is devoted to a consideration of the unsatisfactoriness of the present franchise regulations, the inadequacy of the charter amendments originally proposed, and the necessity for the passage of Amendment No. 34 as submitted by Delos F. Wilcox, E. A. Walcott and Bion J. Arnold.

Under existing franchises no extensions of street railways, gas or water pipes or electric lines can be made. If the proposed amendment is defeated another opportunity to remedy these conditions will not offer itself for two years.

The other charter amendments create a Public Service Commission for the city and county, consisting of three members appointed by the Mayor.

Briefly expressed, the purposes of Amendment No. 34 are:

First—To provide in the charter a "blanket" enabling act, outlining the general terms under which detailed municipal ordinances may later be prepared by the Board of Supervisors, subject to the referendum vote.

Second—To establish the foundation for a comprehensive franchise or administrative code, defining in specific terms the conditions and limitations under which all new franchises may be granted by the city to private operators.

Third—To empower the Board of Supervisors to carry out a comprehensive resettlement or adjustment franchise policy by means of which existing grants to private operators may be merged into those of new or adjusted grants containing specific conditions calculated to remove the present obstacles to adequate service and continued expansion.

RATE FIXING AND APPRAISAL

Practical Illustration in the Determination of Gas Rates.

(Concluded.)

BY C. L. CORY.

In order to set forth some additional information in connection with such a gas manufacturing plant and distribution system, it may be assumed in the various analyses, and perhaps with good reason, that the intangible value or going value of the business has been exaggerated. In this particular instance, the going value has been assumed to be the equivalent of about 10 per cent of the total value, although in arriving at the going value, the actual cost of developing the business has been utilized and it is merely a coincidence that the going value in the aggregate is equivalent to about 10 per cent of the total value of the system.

Again, it is possible that the existing value, or the original cost less depreciation to date, to which is added a sum estimated to be equivalent to the value of the going concern, should be used instead of the value of the plant and system based upon the cost of reproduction new to which is added the going value of the company with its established business.

Tables VI to X inclusive give the figures based upon the existing value of the gas manufacturing plant and sytem, which tables should be compared with Tables I to V inclusive, which give the figures based upon the total value undepreciated.

Table VI gives the total existing value, or investment, as $290,000 which when compared with the former figure of $362,500 would indicate that the total depreciation to date is $72,500.

Table VI is similar to Table I and shows the depreciated investment per thousand cubic feet of gas installed capacity as $1.93, the investment per thousand cubic feet of gas manufactured, $4.09, and the investment per thousand cubic feet of gas sold $4.84.

TABLE VI.

Existing value of gas manufacturing plant including holders, distribution system and services, meters, etc., per installed capacity—per 1000 cubic feet of gas manufactured and per 1000 cubic feet of gas sold.

Portion of System—	Investm't.	Investment per 1000 Cu. Ft. Installed Capacity	Gas M'f'd.	Gas Sold
Gas Manufacturing Plant	$156,000	$1.04	$2.20	$2.60
Distribution System	100,000	.66	1.41	1.67
Services, Meters, etc.	34,000	.23	.48	.57
Totals	$290,000	$1.93	$4.09	$4.84

Tables VII, VIII and IX show the items and the totals which enter into the generating, distribution and serving, metering, billing and collection costs, and Table IX gives the summary as well as the total annual revenue required to meet operating expenses and provide an adequate return upon the investment as well as the average rate per thousand cubic feet of gas sold.

TABLE VII.

Annual Generating Costs and Cost of Generation per 1000 Cubic Feet of Gas Sold.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$12,480	$0.208
Taxes	Based upon gross receipts	1,245	.021
Depreciation	Av. on depreciable portion—5 per ct.	5,350	.089
Oil		14,300	
Station wages, maintenance, operation and station supplies		10,150	.169
Total		$43,525	$0.726

TABLE VIII.

Annual distribution (not including services, meters, etc.), charges, and cost per 1000 feet of gas sold, and delivered to customers.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$ 8,000	$0.134
Taxes	Based upon gross receipts	800	.013
Depreciation	Av. on depreciable portion—3 per ct.	3,250	.054
Maintenance and operation		5,900	.098
Total		$17,950	$0.299

TABLE IX.

Annual services, metering, billing and collection charges and cost per 1000 cubic feet of gas sold and delivered to customers.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$ 2,720	$0.046
Taxes	Based upon gross receipts	400	.007
Depreciation	Av. on depreciable portion—4 per ct.	1,750	.029
Salaries, wages, office expense, etc.		12,000	.200
Total		$16,870	$0.282

If the value of the plant as depreciated to date, including the proper estimate of the additional value as a going concern, is $290,000, the total annual revenue necessary is $78,345. If no more than 60,000,000 cubic feet of gas per annum can be sold, the average return is practically $1.31 per thousand cubic feet. In other words, if the rate for gas service is based upon the value of the plant new, the selling price of gas would be $1.40 while on the other hand the rate would be $1.31 per thousand cubic feet if the rate for gas service were determined upon the existing or depreciated value of the entire plant.

At this time it may be well to state that when a public utility company charges off each year a bona fide sum to cover depreciation, then either one of two methods should be followed by such a corporation.

First:—That there be expended, not each year necessarily, but on the average throughout the life of the system, an amount equal to this depreciation fund in order that the plant and system may be maintained in its original or 100 per cent condition.

Second:—If this is not done by such a public utility company, then the rate of return should not be based upon the cost of reproduction new but in equity upon the existing value which may in general be determined by reducing the original value by the depreciation of the plant and system to date.

Referring to Tables V and X, there is an important fact to be noted.

It would seem that in certain portions of California, we are soon to be provided with natural gas. It may not be necessary to artificially manufacture gas as heretofore. I have heard it stated by many very well-meaning laymen that when this natural gas is available, it can be delivered to the customers of the present gas companies for a very small fraction of its present cost. Let us see what would be the result of delivering gas at no cost whatsoever to this small community of about 12,000 inhabitants, if this natural gas is distributed to customers throughout the present distribution systems.

As set forth in Table V, the total cost of distributing,

serving, metering, etc., per thousand cubic feet of gas sold is the sum of $.332 and $.293 or $.625.

In Table X, the corresponding cost of distributing, serving, metering, etc., is the sum of $.299 and $.282, or $.581. In other words, assuming that such local

TABLE X.
Total Cost of Gas Service per 1000 Cubic Feet of Gas Sold, and Delivered to Customers.

Item—	Yearly Total	Per 1000 Cu. Ft.
Generation	$43,525	$0.726
Distribution	17,950	.299
Service, metering, etc.	16,870	.282
Total	$78,345	$1.307

gas manufacturing and distributing companies were to receive the natural gas free of any cost whatsoever (which is manifestly absurd as a business proposition) and in addition were not allowed even interest and depreciation upon their present manufacturing plants, because they would probably be idle, the rate for gas service in this community would be about 60 cents per thousand.

Figure I shows graphically by curves some interesting facts relating to the plant which I have used for the purposes of illustration. From 1905 to 1912, records were available so that these curves could be compiled. The figure includes the following curves:

1. Gross earnings.
2. Quantity of gas sold annually.
3. Cu. ft. of gas sold per customer per month.
4. Number of customers.
5. Number of meters.
6. Number of services.
7. Gross return in dollars per thousand cu. ft. of gas sold.
8. Rate per thousand cu. ft. of gas delivered to customers.

These curves vividly illustrate some of the points to which reference has been made above.

Some of the risks involved in the gas industry in a small, isolated community were referred to. The effect of the financial panic in the latter part of 1907 and 1908 upon the business of this company is observable at a glance. The gross earnings from 1905 steadily increased until 1908 and there then resulted a general stagnation in the business which continued for more than two years. Quite independent of the rate per thousand cubic feet of gas sold the quantity delivered to customers suffered a decided reduction.

Curve 3 is of the most vital importance to those interested in the manufacture and sale of gas. Beginning with the latter part of 1906 the consumption of gas per customer began to increase from 1,900 cubic feet per month until three years later it was 2,700 cubic feet per month, or an increased consumption per month per customer of nearly 50 per cent. When the effect of the financial stringency began seriously to be felt, however, the consumption per customer again decreased so that even at the same rate or cost per thousand cubic feet of gas, the consumption per customer per month was on December 31, 1910, reduced to 2,300 cubic feet per month per customer. After this date the consumption per month per customer was still further reduced, due possibly to an increase in the rate or cost of gas per thousand cubic feet, to 2,000 cubic feet per customer per month on January 1, 1912, since which date there is some indication of improvement.

As repeatedly maintained, all efforts to increase the average consumption of gas per customer tends to decrease the price at which gas may be sold and, again, with good service, a decrease in the price at which gas may be sold acts as a stimulant to increase the sales not only in the gross but in the consumption per customer as well.

The development of industrial business or the consumption of gas in large quantities, if such is possible in the community, and the introduction of new and economical gas appliances for domestic purposes are both very effective in increasing the amount of gas used per service or per customer.

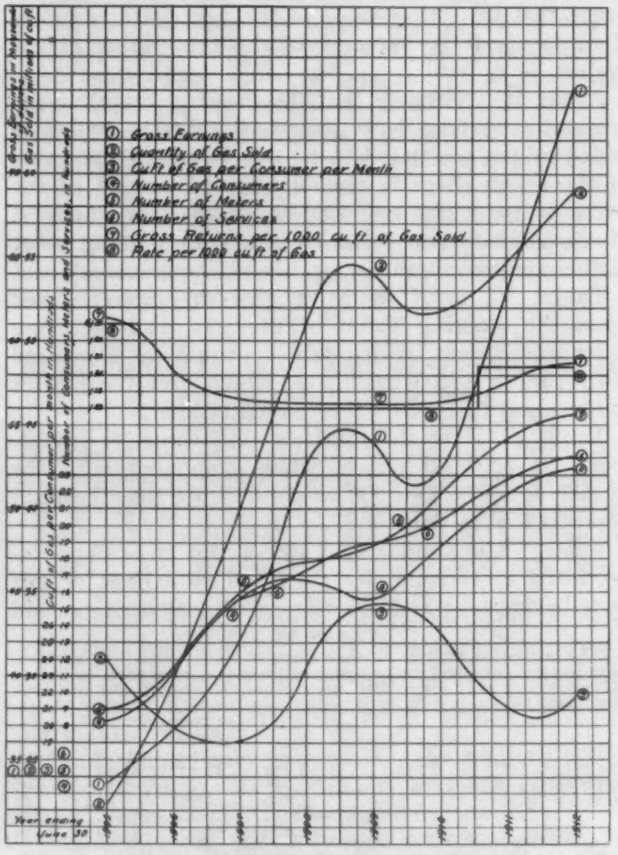

① Gross Earnings
② Quantity of Gas Sold
③ Cu ft of Gas per Consumer per Month
④ Number of Consumers
⑤ Number of Meters
⑥ Number of Services
⑦ Gross Returns per 1000 cu ft of Gas Sold
⑧ Rate per 1000 cu ft of Gas
Years ending June 30

Fig. 1. Curve Showing Yearly Growth of Earnings and Relevant Data.

Curves 4, 5 and 6 show what happens during financial depressions, either local or general, in rendering many services and meters idle. On June 30, 1907, there was very little difference in the number of services, meters and consumers respectively, but two years later there were many idle services and meters which again is not a good business situation for the gas company.

Curves 7 and 8 indicate the average gross return per thousand cubic feet of gas sold and the rate in force at the particular time respectively.

A study of a small gas manufacturing and distributing plant such as the one under consideration indicates what is well-known and extensively practiced on the Pacific Coast, namely, the increased economy and better service resulting from a large gas generating plant

from which is distributed at high pressure the gas used in a number of small communities. The fixed charges in the manufacture of gas bears such an important relation to the total cost of manufacture that increasing the amount of gas made in a single plant very materially reduces the total cost of the gas delivered to the holder.

Finally it is evident that it may not be best for a small gas company in analyzing the situation, somewhat as above indicated, to conclude that it is desirable to attempt to maintain a rate for gas of $1.30 of $1.40 per thousand cubic feet of gas sold. Much better would it be to make every effort, which must include the best possible service, to increase the output of the plant and the resultant gas sales to the end that everybody would be benefited, the company as well as the people of the community. The proper development of a city and its environs will be the more fully realized if from a given gas manufacturing plant and system, 90,000,000 cubic feet of gas may be sold at an average rate of $1.00 per thousand instead of 60,000,000 cubic feet of gas being sold at a 50 per cent greater rate or $1.50 per thousand. The required increase in investment, even if such is necessary, will not be in proportion to the increased sales, and good service and cheaper gas, with the rapid advances being made in domestic gas appliances, can only result in a reasonably prosperous community, in a permanent increase, not only in the total gas sales, but also in the amount of gas delivered to each customer during any given period.

PROPOSED LAW FOR EXPERT WITNESSES.

An act to amend the Code of Civil Procedure of California by adding thereto a new section to be numbered and known as Section 1871, relating to expert witnesses, their appointment by the Court, or a judge thereof, and providing for their compensation and manner of examination.

The People of the State of California, represented in Senate and Assembly, do enact as follows:

Section 1: A new section is hereby added to the Code of Civil Procedure of California, to be numbered and known as Section 1871, and to read as follows,

1871: Whenever it shall be made to appear to any trial court, or judge thereof, either before or during the trial of any action or proceeding, civil or criminal, pending before such court, that expert evidence is, or will be, necessary or desired by the court or any party to such action or proceeding, such court or judge may, on motion of any party, or on motion of such court or judge, appoint one or more experts to investigate and testify at the trial of such action or proceeding relative to the matter or matters as to which such expert evidence is, or will be necessary or desired and such court or judge may fix the compensation of such expert or experts for such services in addition to his or their services as a witness or witnesses at such amount or amounts as to the court or judge may seem reasonable. In all criminal actions and proceedings such compensation so fixed shall be a charge against the county in which such action or proceeding is pending and shall be paid out of the treasury of such county on order of the court or judge. In all civil actions and proceedings such compensation shall, in the first instance, be apportioned and charged to the several parties in such proportion as the court or judge may determine and may thereafter be taxed and allowed in like manner as other costs. Nothing contained in this section shall be deemed or construed so as to prevent any party to any action or proceeding from producing other expert evidence as to such matter or matters; but where other expert witnesses are called by a party to an action or proceeding they shall be entitled to the ordinary witness fees only and such witness fees shall be taxed and allowed in like manner as other witness fees. Any expert so appointed by the court may be called and examined as a witness by any party to such action or proceeding or by the court itself and, when called and examined by the court, may be cross-examined by the several parties to the action or proceeding in such order as the court may direct. When such witness is called and examined by the court, the several parties shall have the same right to object to the questions asked and the evidence adduced as though such witness were called and examined by an adverse party.

This act has been submitted for the approval and suggestions from the California Sections of the several engineering and architectural societies, as well as the Bar Association and the medical societies. H. W. Crozier, chairman of the San Francisco Section of the American Institute of Electrical Engineers, has appointed a committee consisting of A. M. Hunt, F. G. Baum and A. H. Babcock to report at the meeting on November 29th.

In connection with this matter it is of interest to note the opinion of John M. Olin of Madison, Wis., who is handling the Tucson Rate Case, and to whom the matter had been previously submitted:

"It would seem to me a pretty grave question as to whether it is wise at this time to have any law passed that should provide for the appointment by the court of expert witnesses on engineering matters. I think that such a law as this in relation to proceedings in court in criminal cases would be a good thing.

"If such a law was passed, it should be so passed that before any person is appointed by the court as such expert, the parties interested should be notified and an opportunity given as to what person or persons should be appointed. In other words, the matter ought to be placed in very much the same situation as in the case of the appointment of arbitrators or the appointment of a commission to determine the value of property. If the law was framed so as to have thrown about it the proper safeguards, good might come of it.

"The law ought also to provide that nobody could be appointed who was in any way interested in the controversy."

ELECTRICITY PRODUCES FOURTH LETTUCE CROP.

According to the Post-Intelligencer of Seattle, by using electricity, the Walla Walla Hot House Vegetable Company has "slipped one over" on lettuce, and as a result four crops are now grown where only three were produced. The theory is that lettuce doesn't know when night comes and keeps on growing. Results are obtained by the use of eight 2000 candle power flaming arc lights as soon as the sun goes down.

TO DEMAGNETIZE A WATCH.

Suspend the watch by a strong cord; twist the cord so that when released the watch will spin for several seconds, release it, and while the watch is spinning slowly approach it with the positive pole of any strong magnet and then slowly withdraw the magnet. Do this a number of times and be sure that the magnet is not near the watch when it ceases to rotate or afterward.

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POWER AND GAS

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The Expert Witness and the Court

Too long have engineers suffered from partisan criticism in hotly contested legal controversies. The expert, paid and retained by a party to an issue, though acting to the best of his knowledge and belief, still invokes the undertalk of the opposite side when an opinion is given that materially affects the ultimate outcome of the suit. Of late years, the engineering profession has assumed an ethical standing in the professional world that places it in the foremost rank of honor and trust. Why, then, should our laws and court procedures be such that the expert be placed often in a compromising position? It is unjust to the high ideals entertained by the engineering fraternity at large.

The Pacific Association of Consulting Engineers, some months back, undertook a campaign to alter the court procedure in the retaining of expert witnesses. Not only have the engineers of the coast been considered regarding this effort, but also the medical and particularly the legal fraternity have been informed and asked to co-operate. Among the latter class of men a firm endorsement of the agitation is heard on all sides. As our legislators are largely drawn from the legal fraternity, this augurs well for possible fruitful results. Already a proposed amendment to the Code of Civil Procedure of California is going the rounds. A copy of this proposal may be found on another page of this issue. As the agitation in California is the first of its kind to materialize in the West, the other commonwealths of the West will watch the progress with much interest.

The duties of the consulting expert witness are truly of the most unbiased nature—the speaking of the truth brought to consciousness in the expert's mind after years of effective and thoughtful experience. No partisan leaning should ever be tolerated; nor will the engineer, faithful to the high ideals of his profession, allow his testimony to have the faintest touch of partisan coloring. The present practice of the courts, nevertheless, puts the engineer in the embarrassing position of being called upon to speak the dictates of unprejudiced judgment and yet having to bear the sting of bitter insinuations should that decision lean toward his client.

Any enactment empowering the retaining of engineers by the court to appear as witnesses must, however, be considered with the most thoughtful reflection. Undoubtedly in criminal cases such procedure, under the proper safeguards, may prove beneficial. On the other hand, the ends of justice in suits involving damage claims and other forms of civil procedure may often go far astray under the combination of a dishonest judge and an unscrupulous self-heralded expert.

It would seem that a proper solution of the difficulty would be for an enactment empowering the court to appoint an expert, when needed, similar to the method usually in force in the appointment of arbitrators or commissions in the fixing of property valuation.

This would give all parties interested in the controversy due notice of the appointment of such experts and likewise there should be given a full opportunity to investigate the fitness of such appointees and an opportunity to file objections thereto. Add to this the stipulation that no one in any manner interested shall serve on such commission and also include a clear and concise definition of what constitutes the expert and such an enactment may be made to materially serve the ends of justice.

Electric Smelting of Iron

The readers of this journal have followed with interest week by week, the unfolding of new applications of electrical energy on the farm. It is interesting to note that industrial applications, too, are not lacking. Perhaps no more potent industrial application for development of Western manufacturing is possible than that of the opening up of the great bodies of iron ore found throughout that district lying west of the Rocky mountains.

While iron deposits have been found in quantities in many sections of the West, nature has distributed these blessings with lavish hand throughout the great state of California. On the Pitt River and the McCloud River, for instance, the contact between the diabase and the carboniferous limestone seems to be especially rich in magnetite. In reports of the U. S. Geological Survey it is stated that these ore bodies have been opened to a width of 40 ft. without exposing their limits and the occurrence of a vertical dip situated on the north slope would seem to indicate depth. The ore analysis runs 70 per cent iron, 1 or 2 per cent insoluble material, and only a trace of sulphur.

The problem of electrically smelting iron is not new. As early as 1880, Sir Wm. Siemens experimented upon these processes and his four conclusions are well borne out today, namely, that the electric smelters furnish a degree of temperature attainable theoretically unlimited. In the second place fusion may be effected in a perfectly neutral atmosphere. Again fusion can be carried on in a laboratory. And, finally, the limit of heat practically obtainable with the use of ordinary refractory materials is very high because in the electric furnace the fusing material is at a higher temperature than the crucible. On the other hand in the ordinary fusion, the temperature of the crucible exceeds that of the material fused within it.

After a number of years of careful investigation, the iron smelter at Heroult, in northern California, is now producing daily eighteen to twenty-one tons of high grade pig iron. The estimated cost of operating this plant on a commercial scale averages around $14 per ton. The successful consummation of this series of experiments means untold promise to our commercial West. Not only does it mean an unsurpassed market for enormous electrical powers, nor does it only mean the production of millions of dollars in natural wealth from the great undeveloped resources of the commonwealth of California, but even more, for it is difficult to foretell the hundreds of avenues of industries into which these dollars set moving will ultimately wend their way. The advent of oil has meant an untold blessing to the encouragement of manufacturing but now, with the promise of an iron output at rates comparable to Eastern conditions, the future of Western industries is indeed most bright.

Readiness to Serve Methods

"Back to the farm" has of late been so thoroughly discussed in the magazines of the country that some are prone to say the expression is hackneyed. The fact remains, nevertheless, that so emphatic has grown this movement, the power companies now find it to their interests to join in the stampede. Such an unprecedented awakening on the part of the central station calls into life new effort, new modes of procedure and, withal, an evolution in "Readiness to Serve Methods," as different from the city practice as is the rural life of the farmer from that of his well-groomed brother in the densely populated centers.

In the rural communities the organization of the sales force and the method of tabulating data must of necessity be different from the urban practice. Since the farmer leads an entirely different life in entirely different surroundings, the methods of approach on the part of the salesman must be in tune with these new surroundings. Modernizing the farm house, the barn, the bunkhouse and the dairy present new problems and especially so as cost data is meagre upon these subjects. Irrigation costs when storage reservoirs are not used, or when operated with such an elastic supply of water, add their quota of complications. Then, again, reclamation, drainage and pumping upon the low lands of the great valleys of the Sacramento and San Joaquin present new and promising fields of endeavor. Such cost data as does exist have never been published in detail. As to how a trouble or investigating department should be maintained and operated in a rural community likewise presents interesting features wholly different from similar organizations in the concentrated urban distribution centers. Finally, a discussion of rates to be charged in various classes of rural electrical application is of timely interest.

Ross B. Mateer contributes in this issue, the first of a series of sixteen articles which he is preparing on "Readiness to Serve Methods," with especial emphasis for the agricultural community. Mr. Mateer, as manager in charge of agricultural sales for the Great Western Power Company, has ample opportunity to observe and collect the best and most reliable data available. With a college engineering degree in 1899 and a three years' apprenticeship course following at the Westinghouse Electric & Manufacturing Company's Works, his scholastic training is of the best. Next followed years of professional service in Denver and New York, especially devoted to introduction of electric appliances and new power applications, under the various Doherty interests. At the former city he was connected with the Denver Gas & Electric Company and in the latter with the Combustion Utilities Company.

With such splendid experience in former years, and with an active life now busily engaged in the thick of an agricultural sales campaign in the Sacramento valley, our readers have in store in the contributions of Mr. Mateer, a rare treat.

PERSONALS.

G. I. Kinney, Pacific Coast manager of the Fort Wayne Electric Works, is at Seattle.

F. G. Leggett, Pacific Coast manager of Western Electric houses, is making a two weeks' business trip to Seattle.

H. A. Lauritzen, Pacific Coast manager for the Holophane Works of the General Electric Company is at Los Angeles.

Jos. Endert, manager and proprietor of the Valley Electric Supply Company at Bakersfield, Cal., was at San Francisco this week.

E. B. Bumsted, vice-president of the Oro Electric Corporation with headquarters at San Francisco, left for a two weeks' Eastern trip early this week.

E. P. Warner, formerly manager of the Western Electric Company's arc lamp department, has returned to Chicago, after a month's stay in San Francisco.

J. E. Watkins has returned to Vancouver, B. C., after inspecting the construction of the B. C. Electric Railway Company's new turbines at San Francisco.

C. H. Morse, Sr., president of Fairbanks, Morse & Company, and **W. E. Miller,** vice-president, are making a tour of inspection of the company's Pacific Coast offices.

Chas. W. Kendall has joined the sales department of the Utah Power Company at Ogden, Utah, having resigned from a similar position with the Des Moines Electric Company.

G. M. Simonson, formerly with the State Department of Engineering, at Sacramento, is now in the drafting department of the United Comstock Pumping Association at Virginia City, Nevada.

G. R. Cardinal has just joined the sale force of the Pacific States Electric Company as specialist on heating devices and fan motors, arriving at San Francisco this week from Schenectady.

L. H. Newbert, manager of the appliance department of the Pacific Gas & Electric Company, will attend the convention of the National Commercial Gas Association, at Atlanta, Ga., on December 26, 1912.

E. F. Sise, managing director of one of the Western Electric allied houses at Montreal, recently spent a few days in San Francisco, on his way home from an extended trip throughout Western Canada.

R. F. Oakes, general manager of the American Ever Ready Company, has returned to San Francisco from a month's trip through the East. Early in December he plans to leave on a five months' trip through the Orient.

Wm. T. Maddix, formerly superintendent of the southern division of the Pacific Electric Railway Company at Los Angeles, has been appointed assistant general manager of the Utah Light & Railway Company at Salt Lake City.

John Coffee Hayes, president of the Mt. Whitney Power & Electric Light Company of Visalia, Cal., was at San Francisco this week with regard to the California Railroad Commission hearing authorizing his company to issue $250,000 in bonds for new construction.

R. H. Beamer of Woodland, Cal., has been appointed general manager of the Yolo County Consolidated Water & Power Company, which plans to utilize the water from Clear Lake, Cal., for an irrigation and power development. **Roy M. Pike** is president of the company.

D. E. Widdersheim, formerly superintendent of the gas and water departments of the Oregon Power Company, Eugene, Oregon, has been transferred to the new business department of the Western States Gas & Electric Company, Stockton, Cal. **A. P. Tillis** has succeeded Mr. Widdersheim at Eugene.

A. R. Rice, inspector of wireless telegraphy, appointed under the new act of congress for the district embracing Washington and Alaska, arrived in Seattle recently. The act which goes into effect December 13, requires that examinations be taken by operators, and compels amateurs to hold their wave lengths under 200 meters.

F. W. Hild, general manager of the Portland Railway, Light & Power Company, has been elected president of the company's Electric Club; the other officers being **A. C. McMicken,** vice-president, and **M. B. Grenfell,** secretary. Arrangements have been made for many of the club members to take up university extension work under the auspices of professors from the University of Oregon.

M. T. Crawford, superintendent of transmission Puget Sound Traction, Light & Power Company, Seattle, Wash.; **H. W. Crozier,** electrical engineer with Sanderson & Porter, San Francisco; **Barry Dibbie,** electrical engineer, with the U. S. Reclamation Service, at Minidoka, Idaho, and **R. W. Lowman,** consulting engineer at Los Altos, Cal., have been transferred to the grade of member of the American Institute of Electrical Engineers.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, and member of the executive committee of the National Electric Light Association, delivered an illustrated lecture on the system and service of the company and on the remarkable developments in electrical power transmission on the Pacific Coast in the main auditorium of the Engineering Societies Building, New York City, on November 14, 1912. This address was given on the invitation of members of the national and local electrical engineering societies.

Gordon Kribs, who has been assistant to the chief engineer of the Pacific Power & Light Company of Portland, Oregon, for the past two years, has been transferred in the same capacity to the Texas Power & Light Company, Dallas, Texas. Formerly Mr. Kribs was electrical engineer for Smith, Kerry & Chase and had charge of all electrical engineering work in connection with the Mt. Hood Railway & Power Company, which was absorbed by the Portland Railway Light & Power Company. A luncheon at the Portland Hotel, Thursday noon —the 14th—was given Mr. Kribs by the engineers of the Pacific Power & Light Company which was attended by 51 members of the organization. At this luncheon he was presented with a leather bag as a token of the high esteem in which he was held by his associates. Mr. Kribs left for his new position Friday evening, the 15th.

MEETING NOTICES.

Pacific Coast Electrical Supply Jobbers' Association.

The electrical jobbers will meet at Catalina Island, Cal., December 5, 6 and 7 to enjoy the usual golf and other sports here afforded. There will also probably be an open joint meeting between jobbers and manufacturers.

Utah Electrical Club.

At a meeting held at the Salt Lake City Commercial Club, Thursday, November 14, 1912, plans were formed to launch an Electrical Club, to be known as the Utah Electrical Club. Another meeting will be held at the Commercial Club, Thursday, November 21, 1912. D. J. Dinwoodey is temporary chairman.

Jovian Club of San Francisco.

A well attended meeting was held at Tait's Tuesday, November 19th, 1912, at 12:15. N. W. Reed presented a paper entitled "The Relation of the Board of Fire Underwriters to Contractors, Jobbers and Manufacturers." This was followed by an enthusiastic discussion.

Engineering and Architectural Association of Portland.

G. E. H. Bond, manager of the Northwestern Land Products Show, was the speaker at the Engineers' Luncheon on Tuesday, the 12th. He dwelt upon the very pertinent subject of the farmers of Oregon adapting themselves to the country and taking up diversified farming to a greater extent.

San Francisco Section, A. I. E. E.

The regular monthly meeting of the San Francisco Section of the American Institute of Electrical Engineers will be held in the New Montgomery street building of the Pacific Telephone and Telegraph Company at 8 o'clock P. M., November 29. Professor H. F. Fisher will present a paper on "Artificial Transmission Lines." An informal dinner will be held at Jule's Cafe at 6:15, to which all are invited to attend.

Seattle Section A. I. E. E.

The November meting of the Seattle Section, was held November 16th, in the assembly room, eighth floor of the Central Building, under the auspices of the Electric Lighting Group. Howard Joslyn, city electrician, presented a prepared discussion of the inside and outside wiring ordinances of the City of Seattle, several others also presenting prepared discussions. Many of the Electrical Contractors' Association attended and took part in this meeting. The discussions and proceedings were reported by a stenographer and will be published in the Journal of Electricity, Power & Gas later.

A. I. E. E. DIRECTORS' MEETING.

The regular meeting of the Board of Directors of the American Institute of Electrical Engineers was held in New York on Friday, November 8, 1912. Among the matters transacted the president was authorized to appoint a committee on the use of electricity in mines, similar in scope to the other technical committees of the Institute.

The Public Policy Committee reported upon the matters submitted to it at the last meeting of the Board in regard to the patent situation. The committee submitted for passage by the Board certain resolutions addressed to Congress, relating to the American patent situation. These resolutions, which were adopted by the Board subject to the approval of a majority of both the Public Policy and the Patent Committees, urge suspension of action on all patent bills now pending, and the appointment of a commission made up of unbiased, independent, non-partisan men of national standing, to investigate the American patent situation and to recommend to congress such action as may appear expedient.

The Public Policy Committee also reported upon certain communications and senate bills relating to the regulation of water powers, transmitted to the committee by President Mershon for suggestions as to the attitude of the Institute towards the proposed legislation and the advisability of the Institute's participation in hearings on bills of this nature. The following resolution was adopted by the Board, based upon the recommendations made by the committee:

Resolved, When it appears to the president and a majority of the members of the Public Policy Committee, that the question at issue in connection with a bill before congress is one purely of engineering, the board of directors would approve his appointing a committee or delegation to confer with the committee of congress before which the bill is pending, with reference to the engineering questions involved.

The International Electro-technical Commission, through the United States National Committee, acknowledged the receipt of an official invitation from the president and board of directors of the Panama-Pacific Universal Exposition to hold the 1915 meeting of the commission in San Francisco, and requested the U. S. Committee, through the board of directors of the A. I. E. E. kindly to express to the exposition authorities its sincere thanks and appreciation of the honor of being invited to participate in the celebrating of the completion of the wonderful work at Panama, the achievement of which is calling forth the admiration of the civilized world. The board authorized the president and secretary to communicate with the exposition authorities accordingly.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

November 9.

The Railroad Commission effected a reduction from 30 cents to 25 cents in the telephone rates between San Francisco and Hayward, and Oakland and the towns of Mill Valley, Palo Alto, Redwood City, San Mateo and San Rafael. The commission also reached an adjustment with the Western Union Telegraph Company, canceling the extra service charge of 25 cents for delivering telegrams to Stanford University.

The Market Street Railway Company of San Francisco, applied for authority to issue $2,150,000 of gold bonds to be used as collateral security for an issue of $2,350,000 of gold notes of the United Railroads. The United Railroads applied for permission to issue $2,350,000 of notes, the proceeds to be applied toward the payment and discharge of $3,000,000 of bonds of the Market Street Cable Railway and $350,000 of bonds of the Park & Cliff House Railway.

The Southwestern Home Telephone Company of Winchester, Riverside county, applied for authority to raise its rates from 90 cents to $1.50 per month.

November 11.

The Pacific Light & Power Corporation applied for authority to purchase the electric distributing system of the Eagle Rock Water Company, of Los Angeles county, for $22,500, and asked for permission to extend its electrical system in the city of Eagle Rock.

November 12.

The Mt. Whitney Power & Electric Company applied for permission to issue $250,000 of bonds, the proceeds to be used in constructing generating plants and a reservoir on the Kaweah River.

The Little Rock Power & Water Company, of Los Angeles county, applied for permission to issue 3000 shares of stock and $5,000,000 of bonds. The greater part of the stock is desired for use in the purchase of all rights and interests to water and water rights in Little Rock Creek, Los Angeles county. The company proposes to use the proceeds from the $5,000,000 of bonds to construct a power plant and distributing system.

The City of Alhambra intervened in the case in which the Pacific Telephone & Telegraph Company applied for permission to purchase the San Gabriel Valley Home Telephone Company.

Authority was granted to the San Jose Terminal Railway Company to issue $200,000 of bonds for the construction of an electric line of railway from San Jose to Alviso, at tidewater. Arrangements have been made with an existing boat line to handle traffic between Alviso and San Francisco.

November 13.

The Imperial Gas Company, operating in Imperal Valley, filed a supplemental application, asking for authority to issue $200,000 in bonds for the purpose of discharging outstanding obligations and for constructing new gas mains and distributing systems in the cities of the Imperial Valley.

November 14.

The Commission rendered a decision granting permission to the Southern California Utilities Company to issue $10,000,000 of bonds. The proceeds of these bonds will be used for the development of an extensive land and irrigation system embracing 30,000 acres in Riverside county.

A decision was rendered granting permission to the San Diego, Riverside & Los Angeles Railway Company to issue $2,500,000 of bonds. The Commission criticised several transactions of the corporation, calling special attention to the issuance of its entire stock of $8,000,000 between March 12 and March 23, the effective date of the Public Utilities Act.

Permission was granted to the San Diego Consolidated Gas & Electric Company to modify its trust deed to include additional property recently acquired by the corporation.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

ADDENDA TO 1911 NATIONAL ELECTRIC CODE RULES.

Underwriters' Equitable Rating Bureau, Portland, Oregon, November 1, 1912.

Rule 17. **Underground Conductors.**—(Underground services only for D. C.)—

1. When the underground system is extended on the front of buildings and the service is brought through a 2-pole fuse block in the junction box, then when a new service is added for a sign, a motor, or a new lighting service, etc., we require a switch which will disconnect all the wires; i. e., 2-wire service, a 2-pole switch; 3-wire service, a 3-pole switch; and in every case a 2-pole cutout. The neutral for a 3-wire service may be coppered, but the switch on a 3-wire service must disconnect the neutral wire.

2. When the underground service enters a building and passes through a main line switch for this building, then it is optional whether or not an additional switch is furnished.

Underground Services. In all cases except as stated above, underground services should be taken up individually with the Inspection Department.

Rule 19b. **Switches, Cutouts, etc.**—All switches and fuses in basements must be placed in approved cabinets, as they are generally exposed to mechanical injury, piling of stock, etc.

Rule 23d. **Low Voltage Apparatus.**—When an approved transforming device is connected to a primary source of energy, such as a lighting or power circuit, and a secondary volage is obtained, the installation should be classified in the following manner:

(1) When the secondary voltage is 10 volts, more or less, the current being any value, and when the apparatus is used for light, heat or power purposes, both primary and secondary must be installed according to Class C of the National Electrical Code.

(2) When the secondary voltage does not exceed 24 volts, and the current carrying part of the apparatus is not capable of carrying 10 amperes, the system being used for bell-ringing and for similar signaling work, it will be necessary to install the primary wiring only in accordance with Class C, and the secondary according to Class E, of the National Electrical Code.

(3) When the secondary voltage is greater than 24 volts, the current being any value, and the apparatus installed being used for any purpose whatsoever, both primary and secondary must be installed, according to Class C of the National Electrical Code.

(4) When the secondary voltage is less than 10 volts and the current carrying parts of the apparatus are capable of carrying more than 10 amperes, the system being used for any purpose whatsoever, the primary wiring must be installed according to Class C, and the secondary wiring according to Class E, of the National Electrical Code.

Rule 26f. **Wires.**—All attics must be bored and bushed. Knobbing under roof joist and over floor joist will not be approved.

Rule 26k. **Wood Moulding.**—This department will not pass soft woods, such as cedar, redwood, white pine, Douglas fir, etc., for use as wooden moulding. All moulding must be made of hardwood, and have both outside and inside thoroughly painted with at least two coats of waterproof material or be impregnated with a moisture repellant.

Rule 26l. **Wire.**—This rule prohibits the use of moulding in damp places. Moulding, metal or wooden, must not be used on the outside of buildings or in the archway of doors or entrances that open directly on the street.

Rule 26r. **Wires.**—Second paragraph: Porcelain tubes must be used through timbers, walls and partitions. Flexible tubing will not be approved for this purpose. Also the crossing of pipes must be made with porcelain. The porcelain must be in a continuous piece at the point of crossing.

Rule 26r. **Wires.**—Last paragraph: "At distribution centers outlets or switches where space is limited, and the five-inch separation cannot be maintained, each wire must be separately encased in a continuous length of approved flexible tubing."

Four wires may be brought down between 2x4-inch studdings that are 14 inches apart. Six wires may be brought down between 2x6-inch studdings that are 14 inches apart, providing the wires are properly staggered. Headers must be placed as often as 18 inches apart.

Rule 26s. **Wires.**—Flexible tubing must not be used where it is exposed to moisture. Loom must not be used across water or steam pipes or down brick walls. Unless an air space of at least 4 inches between the laths and plaster and brick walls can be maintained, the wires must be run in approved conduit, installed according to Rules 27 and 28. Outlet boxes must not be concealed in ceiling, but conduit must extend to ceiling outlet.

Rule 26u. **Straight Electric Outlets.**—Circular loom must extend at least one inch beyond finished surface instead of one inch beyond backing. This applies to grounded surfaces, such as metal lath, metal ceiling, etc.

Rule 28f. **Interior Conduits.**—All conduit of a greater length than 15 feet and any run of conduit which carries more than 661 watts must be thoroughly grounded. This has special reference to the consumer's connection to the underground system.

Rule 30. **Fixtures.**—To secure safer methods in the installation of outside lights, we will require the following:

The arm of the fixture must be of approved conduit and on the outer end must be equipped with an approved condulet (Type A, B or E, two or three wires) or an approved weatherproof socket securely screwed to the end of the conduit, both to be turned downward. On the end attached to the building, if a crow's-foot is used, an approved condulet will also be required (Type D, two or three wires), but if the conduit extends through the wall it must terminate in an approved outlet box and have the wires separately encased in a piece of continuous flexible tubing from the last porcelain support to the Federal bushing in the box.

The above fixture may be decorated with ornamental iron work in any way desired, but must embody the above requirements.

Rule 30. **Fixtures.**—White or red lead must not be used when insulating joints. Some insulating compound, such as asphaltum, is preferable.

Rule 30a. **Fixtures.**—This department will not approve the following pieces of apparatus for canopy insulators: "Hard rubber or fiber clips for clamping over the edge of the canopies to hold fixtures away from ceilings"; also "Bushings made to insert between the lower edge of canopies and fixture stems."

When the fixtures are "Straight Electric," the fixtures must be supported by an approved insulating crow's-foot and the canopy insulated by an approved canopy insulator.

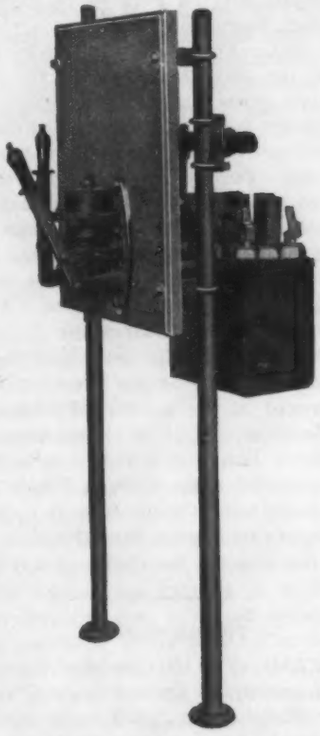
The October, 1911, List of Electrical Fittings gives a list of approved canopy insulators and insulating crow's-feet. Also a contractor may make approved canopy insulators with a strip of fiber at least one-sixteenth inch thick, separating all of the canopy at least three-sixteenths inch from the ceiling. These fiber strips to be securely fastened to the canopy by rivets.

[To be continued.]

INDUSTRIAL

NEW OIL SWITCH.

The smallest oil switch manufactured by the General Electric Company for switchboard mounting is known as the type F, form k-13. It was developed particularly for use in isolated and small plants and will provide adequate protection on a.c. circuits up to 200 amperes and 3300 volts. The general characteristics of this switch are similar to the larger and more expensive switches for switchboard mounting made by this company.



Automatic Triple-Pole, Double-Throw Switch on Panel Supports.

The entire mechanism and oil tank, except operating handle on front of board, are suspended from a single frame. The oil vessel is of heavy sheet metal lined with an insulating material and provided with barriers between poles. The contacts provide two breaks in each phase and open by gravity. They are of the well-known sliding wedge construction which not only gives a wiping motion to the contacts on epening and closing, thus keeping them clean, but also protects the actual current carrying surfaces from damage in breaking the arc.

This switch is made of double, triple and four-pole, non-automatic and automatic for hand operation. It is fully described in the General Electric Company's Bulletin A-4001.

DISPLAY LIGHTING IN A BIG DEPARTMENT STORE.

When the new Bamberger store, in Newark, N. J., was planned, first consideration was given to secure an interior fitted only with equipment which would prove in every way adequate to the demands of a truly modern shop. Foremost amongst other essentials was the consideration of most effectively illuminating the goods displayed.

The interior show cases, aggregate a total of 3865 feet, or over three-quarters of a mile were they placed end to end. In the upper front corner of these cases were fixed Frink standard type of case reflectors with silver ripple reflecting glass to assure practically perfect distribution of light upon the goods within the case. The illuminating effects secured were without glare or shadow and highly gratifying to both customers and sales force.

About 250 feet of Frink window reflectors are used in the street display windows. There were set in a recess formed in the false ceilings about 8 in. from the plate glass front. The rear side of this recess was projected down below the ceiling line in the form of a molding and arranged and worked in as a part of the panelling effect of the ceiling. This projection, while not interfering in any way with the ornamental effect of the window ceiling, eliminates the possibility of "back reflection" which would be liable to occur were the light allowed to reflect directly upon the rear wall of windows.

The illumination of the rug display racks will be rather unique and very effective inasmuch as the arrangement provides for two intensities of light to secure approximately correct lighting effect for each article displayed. This rack consists of a number of inverted right angle triangular frames, pivoted on the vertical side between two horizontal bars so as to swing to and fro like a door or gate.

Arranged in semi-circular form directly outside of the limits of the arc described by the swinging members of this rug rack, and attached to the ceiling by means of permanent fixture blocks, are the Frink reflectors. They are so designed, with regard to diffusion of light by means of the arrangement of the silver ripple glass reflectors, as to uniformly illuminate the whole surface of the rugs under inspection.

A special shield arranged directly below the reflector serves to prevent the light from interfering with the customers vision of the rugs on display.

In the art gallery, which is arranged in the form of bays independent of the walls of the building, the Frink reflectors are supported on arms extending out from the top molding above the pictures. These reflectors are also so arranged as to evenly diffuse the light upon the goods without any reflection into customers' or salesman's eyes. From 15 to 60 watt tungsten bulbs will be used throughout depending upon the strength of illumination desired. This entire installation was handled and installed under the supervision of the H. W. Johns-Manville Company, New York, who are the sole selling agents for the entire line of Frink products.

NEW CATALOGUES.

Catalogue No. 12-A from The Hinman Hydraulic Manufacturing Company of Denver, Colorado, illustrates and describes various Canal and Reservoir Appliances, including head gates, gate lifts and pipe.

The General Electric Company has recently issued several new bulletins. No. A4004, describes the G-E Steam Flow Meter, and supersedes the company's previous bulletin on this subject. No. A4034 is devoted to Long Life Flame Arc Lamp, known as Type "W." This lamp is for street illumination, and is designed to operate on alternating current series circuits. No. A4036 describes Direct Current Exciter Panels for use in connection with alternating current generator panels when, for any reason, speed control of exciters is desired. This bulletin supersedes No. 4917. Isolated and Small Plant Switchboards for use with Gasolene-Electric Sets, and for Alternating and Direct Current, are described in Bulletin No. A4037. While designed primarily for use with the company's Gas-Electric Generating Sets, they are suitable for use in any generating units of the same rating, and are intended for small lighting plants.

NEWS NOTES

INCORPORATIONS.

SEATTLE, WASH.—Pacific Coast Light, Power & Railway Company, of Seattle, $50,000, by Albert H. Robinson, I. N. Robinson, K. C. Robinson.

SANTA MONICA, CAL.—Articles of incorporation have been filed for the Electric Products Corporation, with capital stock of $20,000. The directors are C. I. Hewshem, Frank E. Sweeney and Paul D. Lowse.

ILLUMINATION.

LOS ANGELES, CAL.—The Southern California Gas Company is making preparation to deliver natural gas to Torrance and other outlying districts of Southern California.

GLENDALE, CAL.—Erection of ornamental light standards in the residential section west of Glendale avenue, north of Riverside Drive to the city limits, has been completed and it is expected that lights will be in operation by December 1.

FULLERTON, CAL.—The Southern Counties Gas Company in addition to other improvements in its system in Orange county, will according to President R. Bain of Fullerton, shortly begin the laying of a 4-inch high pressure line to Fullerton.

REDONDO BEACH, CAL.—A petition is being circulated among business men and property owners to have ornamental lights in groups of five installed in the main thoroughfare from Diamond street to Marguerite avenue. It is planned to continue lights from Camino Real up Diamond street later.

LOS ANGELES, CAL.—John D. Reaves president of the San Gabriel Inter-City Commission, presented the proposition that a lighted-way from San Diego to San Francisco along the route taken by the State road, be constructed, composed of concrete lamp posts surmounted by 3 lights every 200 feet on alternate sides of the road.

SILVERTON, ORE.—A twenty-five year franchise has been granted to the Portland Railway, Light & Power Company for the free use of the city streets for carrying on an electric light business here in lieu of the privilege extended to the city in crossing the light company's land with the city water mains from the intake above the city.

MARYSVILLE, CAL.—In an endeavor to enter this county with a light and power plant, General Manager Van Der Nailen of the Oro Light & Power Company, appeared before the Yuba County Supervisors and asked that permission to bid on a franchise to erect poles and carry out the other necessary construction along the county highways outside the limits of incorporated towns be granted his company. Permission from the Railroad Commission has been granted the Oro Light & Power Company to obtain franchises throughout the county except in incorporated towns. The supervisors have taken the matter under advisement.

STOCKTON, CAL.—Three applications for franchises to supply electric power and light in Stockton have been filed. One applicant is the Oro Electric Company, another is John Raggio and the third is J. W. Goodwin, president of the Oro Electric Company. All three applicants are represented by Attorney C. L. Neumiller. Bids for the three franchises will be received December 17. J. W. Goodwin, president; R. L. Vander Nailen and E. B. Bumsted, vice-presidents; and F. H. Garbee, W. H. Orrich and Henry E. Adams were present to represent the interests of the company. They state that their company is prepared to enter the city almost at once and will make a bid for their franchise that will make competition almost useless. The Oro Company is already supplying power and lights for many of the farmers throughout the county in the north and east and its representatives say that the problem of entering Stockton is a small one.

WATERWORKS.

STOCKTON, CAL.—The Pacific Gas & Electric Company has been granted a franchise to lay and maintain water pipes, mains and conduits for the purpose of supplying water to the county of San Joaquin.

EUREKA, CAL.—Frank Langford, who is developing water power at the Ishi Pishi Falls on the Klamath River, to furnish electric power for an ore-reduction plant at Trinidad, has filed on 100 inches of water in Luffenholtz Creek for irrigation, domestic and manufacturing purposes.

SALEM, ORE.—On the site of the Willamette Power Company on the Santiam, in the Breitenbush region, which was recently contested by that company and the Hammond Lumber Company, William Hobson has filed a right in the office of the state water board of control, for 1000 second feet, generating a horsepower of 10,000. A general commercial use will be made of the water.

LOS ANGELES, CAL.—The Public Service Commission will begin plans at once for the distribution of aqueduct waters, as approved at the general election. William Mulholland, chief engineer, is at work on a plan to save approximately $50,000 in the first outlay in bringing into the the city 2000 inches of water through Franklin Canyon line. Work has already begun on a 4000 foot tunnel through the Santa Monica mountains into Franklin canyon, also excavation for the dam for the lower reservoir.

TRANSMISSION.

KELSO, WASH.—The Oregon-Washington Corporation will construct a power line from here to Ostrander.

GLACIER, WASH.—The Washington Anthracite Power Company will build a power plant on Glacier Creek, three and one-half miles from here.

NANAIMO, B. C.—Taylor & Young, engineers, Metropolitan building, Vancouver, B. C., have been awarded the contract for installing a 450 h.p. Howden engine in the plant of Nanaimo Light Company.

MONTESANO, WASH.—The Elma Light & Power Company has filed a petition for a franchise for a term of 50 years to erect and maintain a line of poles and wires along county road between Elma and Satsop. A hearing has been set for December 2d.

LOS ANGELES, CAL.—A. G. Gage is to be allowed the use of the city's proposed transmission line to obtain electrical energy from the Southern California Edison Company, in exchange for the right of way for the municipal transmission line across Gage's property near Saugus.

OROVILLE, CAL.—Work for the season has been stopped by the Oro Electric Corporation at Belden and men, who have been employed building roads from Belden to Yellow Creek, where work upon the $10,000,000 power plant of the company will be started early in the spring, have been laid off for the winter.

LOS ANGELES, CAL.—The special council committee appointed to open negotiations with certain power companies of the city for the acquisition by the city of portions or their systems for a municipal distributing system, will deal only with the Southern California Edison Company and the Los Angeles Gas & Electric Company. These two companies

have begun making appraisal of the systems for the purpose of making a settlement with the city.

QUINCY, CAL.—Three power companies are securing franchises in Plumas county. The supervisors have sold a franchise to the Indian Valley Electric Light & Power Company, which is operating in the northern part of the county. A. G. New, a San Francisco attorney, has made application for a franchise, as has the Oro Electric Company. The latter is building a plant at the mouth of Yellow Creek on the Feather River.

GRANTS PASS, ORE.—The California-Oregon Light & Power Company asked for a 40-year franchise for its system and service in this city, offering as an inducement two per cent of the gross revenues of the company within the city. The proposal was referred to a special committee, composed of the mayor and Councilmen Daniels and Clark, for investigation and report. The same committee is also investigating the proposition made by Geo. Sanders for supplying electricity to the city, the city to own the distributing system.

TRANSPORTATION.

EUGENE, ORE.—LaDeaux & LaDeaux, contractors, Portland, were awarded the contract for building the car repairing shop 35x135 ft. here for the Oregon Electric Company.

TWIN FALLS, IDAHO.—I. B. Berrine, this city, will build an electric line from this place to Shoshone Falls, Snake River a distance of ten miles. Edison storage battery cars will be used.

LEWISTON, IDAHO.—F. L. Strum, Wahpeton, N. D., has deposited $1,000 with the Lewiston Terminal Company as a guarantee that he will furnish electric railway service in the Lewiston-Clarkston valley in six months.

SALT LAKE CITY, UTAH.—That negotiations are on for the sale of the Salt Lake & Ogden Electric Railway to Eastern interests represented here by M. B. Hereley, a traction expert of Chicago, was admitted recently by Simon Bamberger, the president of the road. The deal, if consummated, will involve millions, and it is said by those interested that other millions will be forthcoming to extend the traction system north from Ogden and south from Salt Lake.

LOS ANGELES, CAL.—The council municipal railroad committee has recommended that plans be drawn for the municipal railway system from the city proper to the harbor, together with complete terminals in Los Angeles and a belt line at the harbor, also recommending that Engineer Franklin D. Howell of Los Angeles be employed to draw plans and prepare specifications in order that definite information may be secured so as to put a bond issue before the people in January.

OAKLAND, CAL.—Increased service has been started on the Hayward line during the rush hours of the evenings. Under the new schedule cars will leave Twelfth and Broadway under an average headway of a minute and 45 seconds between 4:57 p. m. and 6:10 p. m. for Elmhurst, San Leandro locals leave every five minutes and Hayward every ten minutes. The first Hayward limited leaves Oakland at 4:47 p. m. and others follow every 20 minutes until 5:57. Construction work is being rushed on the East Sixteenth line, which is expected to relieve congestion on E 14th street. One track is graded from the California Railway to Thirteenth avenue, and the other is being started.

LOS ANGELES, CAL.—The notice of sale for an operative franchise to the Pacific Electric on San Pedro street from Aliso street to 9th street over the proposed municipal railroad, was brought before the city council with the approval of the board of public utilities and action was deferred for a week. This was done in order to allow the Pacific Electric time to examine the plans for the proposed municipal line, completed Monday by the city engineer, and referred to the council by the board of public works. The engineer estimates the cost of the line at $208,540. Accompanying the plans is the form of contract for the construction of the line and inasmuch as the Pacific Electric will bid on the construction work, the officials desired time to examine the form of contract.

SAN FRANCISCO, CAL.—J. W. Riess, vice-president and general manager of the W. L. Holman Company, which has the contract for building the 43 cars needed for the Geary Street Municipal Railway, appeared again in the mayor's office Friday because the ten cars, promised for November 15, would not be ready for two weeks. Superintendent Cashin stated that when he should receive the first ten cars he would be able to establish service on the city's line from Thirty-third avenue to Kearny street, with a headway of about seven minutes. Commissioner Laumeister stated that all the material needed for the lower Market street extension was virtually on hand and that contracts would be let in about two weeks. The conference ended with instructions to Assistant City Attorney Havens to look into the question of whether or not the acceptance of ten cars would bar the city from proceedings against the building company's sureties to obtain damages for violation of contract.

TELEPHONE AND TELEGRAPH.

VALLEJO, CAL.—A direct telephone line between Vallejo and Green Valley will be installed by the city at once.

ALBANY, ORE.—The Home Telephone Company will install an inter-communicating telephone system in the First National bank here.

PRESCOTT, ARIZ.—The telephone system of the Mountain States Telephone Company is now in operation as far as Holbrook, and the extension of the line to St. Johns will be accomplished in the near future.

SPRAY, ORE.—The Spray Telephone Company is soliciting bids for stubbing of Heppner Canyon toll line from Monument Mountain to John Day. Bids received at Spray, Oregon.

DOUGLASS, ARIZ.—F. A. Secord, superintendent of telegraph on the El Paso & Southwestern, has set a crew of men to work stringing two copper wires from Tucson to Fairbanks and will put the line in the best possible service.

LOS ANGELES, CAL.—Bids will be received up to December 3d for the purchase of a franchise granting the right to erect poles, wires, conduits and other appliances for the transmission of electricity, for telephone and telegraph purposes.

OAKLAND, CAL.—Bids will be received up to December 2, 1912, for furnishing one combination central energy private branch exchange and police telephone and telegraph switchboard, set in place complete and ready for constant use in accordance with plans and specifications on file with the clerk.

SAN DIEGO, CAL.—Local officers of the Pacific Telephone & Telegraph Company have announced that a new switchboard of 12 positions will be installed in the San Diego exchange at the first of the year to take care of the rapidly increasing long distance traffic. It is claimed about $10,000 will be expended.

LOS ANGELES, CAL.—The Home Telephone Company of Pasadena, the new name under which the Pacific Telephone & Telegraph Company is operating since the merger of the two systems, plans extensive improvements, which among other things, will embrace the stringing of more than 100 miles of cable. It is estimated that the work will cost a quarter million dollars.

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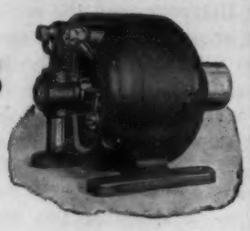

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